

Transcription and validation of lidar using volunteers in the Wyre Forest.

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Abstract

The lidar survey for Wyre Forest is being undertaken as part of the Grow With Wyre, Landscape Partnership Scheme. In terms of its technical context and approach towards transcription of features in the landscape, the Wyre project has much in common with the methodologies and aims of other projects featured in this volume. However, one of the key objectives of this Heritage Lottery Fund led scheme has been to promote volunteer training opportunities and involvement in a range of community projects.

In order to meet this objective, the Grow With Wyre heritage programme was developed to enable validation of transcribed features to be carried out by trained volunteers. Working with a volunteer group has presented a great opportunity to validate a large sample area of the lidar survey, with the aim being to cover 50% of the 72km² project area by spring 2011.

A key challenge of this approach was how to develop a validation methodology that is practical for application by non-specialist volunteers, whilst ensuring that HER data standards are maintained in the final record. Using the format of a one-day workshop, volunteers were introduced to the concept of recording the historic environment using lidar: trained in navigation, feature recognition and validation, with follow-up support from professional archaeologists available when required.

The volunteer fieldwork is still in very much progress. Nonetheless, to date work has been carried out in an area totalling 19km². This paper will present the approach devised to both train and equip the volunteers for lidar validation. It will also draw on the preliminary results to illustrate the successes and constraints of the chosen methodology.

Project background

Grow With Wyre is a three year Forestry Commission led Landscape Partnership Scheme. The project has total budget of £4 million with £1.86 million being provided by the lead funding partner, the Heritage Lottery Fund. The project covers 72 square kilometres of landscape focused on the ancient Wyre Forest, its satellite woodlands and the land and settlements that adjoin or are within the forest landscape (fig 1). Much of Wyre Forest is designated as a SSSI and it is a landscape of mixed ownership; although substantial areas are managed by the Forestry Commission and the Natural England, who manage the large National Nature Reserve within the forest.

Grow With Wyre was developed to deliver five programmes (Wyre Forest LPS May 2008):

- 1) Habitat Protection and Restoration
- 2) Landscape Character and Heritage
- 3) Sustainable Energy
- 4) Education and Skills
- 5) Access

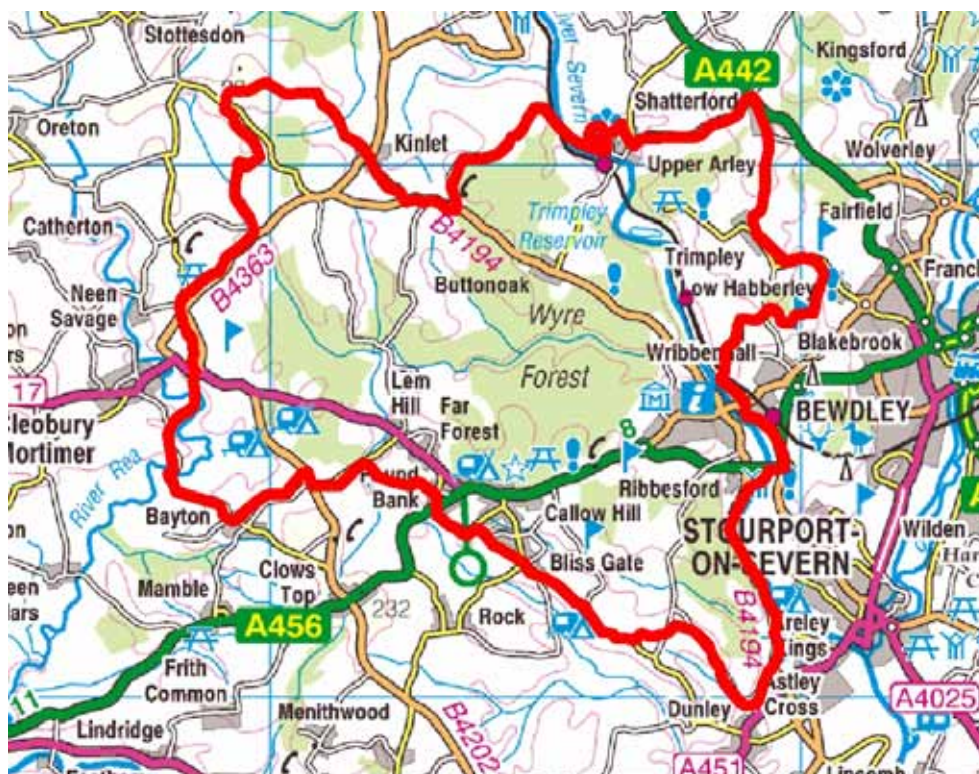


Figure 1: The Grow With Wyre Project area.

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During development of the project, the need to carry out an historic environment assessment and landscape survey was identified, given that Wyre Forest was under-represented on the county Historic Environment Records. Worcestershire Historic Environment and Archaeology Service produced a Historic Environment Scoping Report in 2006 that summarised the range of historic environment features and sources relating to the Wyre and its hinterland at that time. The report identified a significant gap in data, particularly in terms of the historic environment context.

Following the excellent results achieved in the Forest of Dean pilot project (Devereux et al. 2005), Worcestershire Historic Environment and Archaeology Service recommended that a lidar survey should be carried out across the entire *Grow With Wyre* proposed project area in order to provide context and to underpin the heritage interpretation and management aims of the project (WHEAS 2006). The Forestry Commission were equally enthusiastic for a lidar survey, given the wide range of applications available with such data. As a result, the Forestry Commission agreed to fund a lidar survey and post-survey processing by Peter Crow of Forest Research. The survey was carried out over two days in February and March 2007 followed up by processing and delivery of hillshaded images in October 2007.

Historic environment context and potential

Wyre Forest is situated in a valley landscape that has extensive evidence of early prehistoric activity and seasonal settlement (Jackson et al 1996). While excavations at a settlement site in Blackstone, near the river town of Bewdley during the 1970's demonstrated that Iron Age settlement was established at this location during the 2nd to 1st century BC (Hurst et al. 2010), overall there has been a lack of contextual local landscape evidence for land-use during the Iron Age and Romano-British periods. There are, nonetheless, impressive settlement sites that survive as outliers of the current forest; the Roman fort and *vicus* at Wall Town (Walker 1965-68) and the promontory enclosure in Wassell Wood (Bowen 1952).

By the medieval period, control of the chase of Wyre Forest and its land fluctuated between royal and manorial ownership (Shropshire Council 2010) with substantial areas of park established and enclosed. The dispersed settlement pattern of Wyre probably began to develop at this time along with evidence of early iron workings adjacent to Baveney Brook (Chapman 1993).

Industrial exploitation of mineral resources, woodland products and settlement continued to develop and expand during the post-medieval and modern centuries. Following construction of the Bewdley to Woofferton railway line in 1864, fruit growing, forest crafts and deep coal mining flourished during the 19th and early decades of the 20th century followed by a rapid decline, which included closure of the railway line in 1964.

Prior to 2007, historic environment research in Wyre had concentrated on specific themes; such as Wyre's industrial heritage and in particular its association with coal mining (Poyner and Evans 2000). Other areas of research focused on specific locations; for example, the strip and record survey of 'The Hermitage' in the heart of Wyre (Quayle 1990). Despite the low number of sites recorded on the Historic Environment Records Wyre was considered to have a high historic environment potential for features relating to historic management of the forest and those associated with the pre-forest landscape. The greatest potential, in common with similar projects, was that lidar would reveal the historic environment setting of features, provide an insight into the evolution of the landscape and expose the inter-relationships between different features. The survey would also reveal the connections between the internal and external landscapes of the Wyre and its setting.

Lidar and transcription methodology

The *Grow With Wyre* Project is largely based on the methodology developed by Gloucestershire County Council for the Forest of Dean Project. The survey area has been divided into 1km² sections based on the OS national grid covering a total area of 72km². Features identified in the lidar images that are considered to be of historic environment potential have been digitally mapped in GIS as either single or group features. A single unique number has been used to identify each digitised point, polygon or line, regardless of the actual number of lidar features this represents. The feature numbers follow the convention set in the Forest of Dean Project: constructed of an alphanumeric reference for the OS 1km grid square followed by an internal feature number for each 1km square

Development of the volunteer programme

A key objective of this Heritage Lottery Fund led scheme has been to promote volunteer training opportunities and community involvement in a range of projects embedded in all five programmes. During development of Programme 2, it was considered that one way of meeting this objective would be to offer training for volunteers to carry out field validation of transcribed features with support provided by professional archaeologists.

This approach presented a number of benefits and challenges. If a volunteer group of sufficient numbers could be recruited then it would offer a good opportunity to validate a large sample area of the lidar survey. Indeed, the aim is to cover 50% of the 72km² project area by spring 2011. The wider benefits include opportunities to work with local people who have a great knowledge of different parts of the forest; often this is a result of many years of work in the forest or as a result of volunteer work with habitat survey programmes. In terms of challenges, the most testing was how to develop a methodology and effective training programme that would enable people from different backgrounds and with different experience and expectations to carry out a survey that will provide consistent results that will meet the national data record standards expected by the county Historic Environment Records.

It was recognised as a result of experience learned through established volunteer projects, such as the *Worcestershire Ridge and Furrow Survey Project*, that any methodology should be clearly-structured and adhere to data standards, but it also needed to be straightforward to follow and easy to apply in the field.

The methodology and training of volunteers

The foundation of the validation methodology was modelled on that of a rapid walkover survey and condition assessment of earthworks. Speed, accuracy and portability were therefore key considerations during development of the methodology. In order to facilitate this, the amount of equipment to be carried was reduced to a minimum; based on volunteers working in pairs over some distance and often over challenging terrain. This was, to some degree, influenced by the need to minimise risk of volunteers becoming encumbered by too much equipment, but it was also considered important to encourage volunteers to carry out efficient and therefore rapid evaluation.

The recording method was based on a landscape survey record sheet used for walkover surveys designed to inform historic environment management plans; often within the context of Environmental Stewardship agreements. This record is used to capture contextual information and to record feature condition including agents observed that are affecting condition. The fundamental principals for validation of the Wyre survey have focused on three themes:

- 1) Validation of features to confirm whether they are historic environment features or some form other physical structure (in the broadest sense) recorded by the lidar
- 2) Interpretation and observation of the physical attributes and relationships between features
- 3) A simple condition assessment based on observed groundcover, local conditions and any detrimental indicators or factors affecting condition

The first two principals are aimed at informing interpretation and promotion of individual features and groups of features in their landscape context. The third

The need to provide clear and practical survey maps presented its own challenge with a number of different options considered in the lead up to the first workshop. With the transcription of the lidar features based on kilometre squares, it seemed logical to approach validation using the same spatial approach. Survey maps were produced at a scale of 1:5,000 each covering a kilometre square and printed on A3 paper. A range of map options, which used different base mapping and feature display properties, was produced for the first workshop. These were effectively draft maps that could be both tested during the workshop and adapted based on the experience of use during the day and feedback from the volunteers.

A series of workshops were planned to introduce volunteers to the fieldwork. In advance of this, a programme of talks to promote the project and lidar results was carried out during 2008 - 2009 to local societies and groups that have a range of interests. Aside from promotion and outreach, the talks were also aimed at recruiting individuals who would be interested in joining the validation project. Lidar produces compelling results that raise considerable interest, particularly to those living in or close to the landscape that is the subject of study. As a result, the level of interest was high and the first workshop was organised for August 2009.

The format of the first workshop was thus:

Training was arranged for twelve individuals; a number that was considered to be an ideal maximum in terms of providing sufficient support for six pairs. The workshop covered a period of one day divided into two sessions: a morning classroom session followed by an afternoon of fieldwork training.

The morning session introduced the technique of lidar, including its strengths and weaknesses, and presented a brief overview of the results in Wyre. This was followed by a tutorial on rapid walkover survey; an introduction of the method developed for Wyre validation; the range of maps that would be used and the equipment selected for each pair of volunteers.

The afternoon practical session was held on Pound Green Common; an area of Wyre that has mixed land-use of SSSI heathland and ancient semi-natural woodland. The heathland is in 'improving' condition following a decade of restoration carried out under Countryside Stewardship, nonetheless, the site still has areas of bracken and scrub cover. Pound Green Common therefore provided an excellent training ground, given the mix of ground cover conditions and range of historic environment features (plate 1).



Plate 1: the mixed environment of Pound Green Common.

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The practical session followed the format of a group tutorial that covered feature recognition, text and sketch recording and condition assessment, followed by a tutorial in navigation using a compass. While this might be considered somewhat 'retro' in the age of satellite navigation, there are a number of reasons that led to the choice of compass over GPS. Professional standard GPS systems operate at a very high or at least acceptable level in most conditions. By contrast, most affordable hand-held GPS units offer a respectable level of accuracy in open, level terrain or on higher ground. However, experience has demonstrated that GPS accuracy and overall performance deteriorates in wooded or valley landscapes; combine the two (as in Wyre) and the effect becomes a real constraint. Navigational unreliability carries a degree of risk in a landscape with the challenging terrain and extensive woodland cover of Wyre. Competence in map reading and compass navigation provides the volunteers with a method of, at the very least, being able to follow a direct bearing, and therefore, clear the Forest before nightfall; a particular consideration during the winter. Finally, the cost of purchasing up to fifteen GPS units could not be justified within the Programme 2 budget. Indeed, the total cost of purchasing fifteen compasses was comparable to the equivalent cost of just one GPS unit.

The final task in the practical session involved each pair of volunteers set the task of navigating to a feature, which once located, they then had to produce a profile drawing and fill out a record card.

Each pair of volunteers was issued with a set of three A3 maps each covering the same area based on the one kilometre survey square. The set was comprised of (see also fig 3):

- 1) Hillshaded lidar image (lit from the north-west) with OS mastermap data and the transcribed features.
- 2) OS Mastermap basemap with transcribed features and no lidar.
- 3) The hillshaded image with no other data or transcribed features.

The chosen combination of maps provided the volunteers with the necessary 'hard detail' to aid location and navigation. The lidar maps were particularly useful for showing 'soft detail', such as areas of scrub or individual trees. Again, these proved useful waypoints for navigation. The plain lidar map was provided entirely at the request of the volunteers who wished to see the features in detail, as recorded by the lidar, with transcription data removed.

In certain cases, where feature density is high, it has been necessary to provide a fourth map showing a close-up of that particular area; simply to enable the volunteers to read the feature labels, which can become cluttered on the main survey maps.

The workshop concluded with a debriefing session and, particularly in the case of this first workshop, a discussion of the methodology, maps and recording format; although discussions during each of the following workshops provided useful observations that led to adjustments on the record card. The discussions proved very helpful given the range of experience and interests of the volunteer group. The feedback led to the adoption of a final set of survey maps and some edits to the recording form, all of which went on to inform the next two workshops held in September and October 2009.

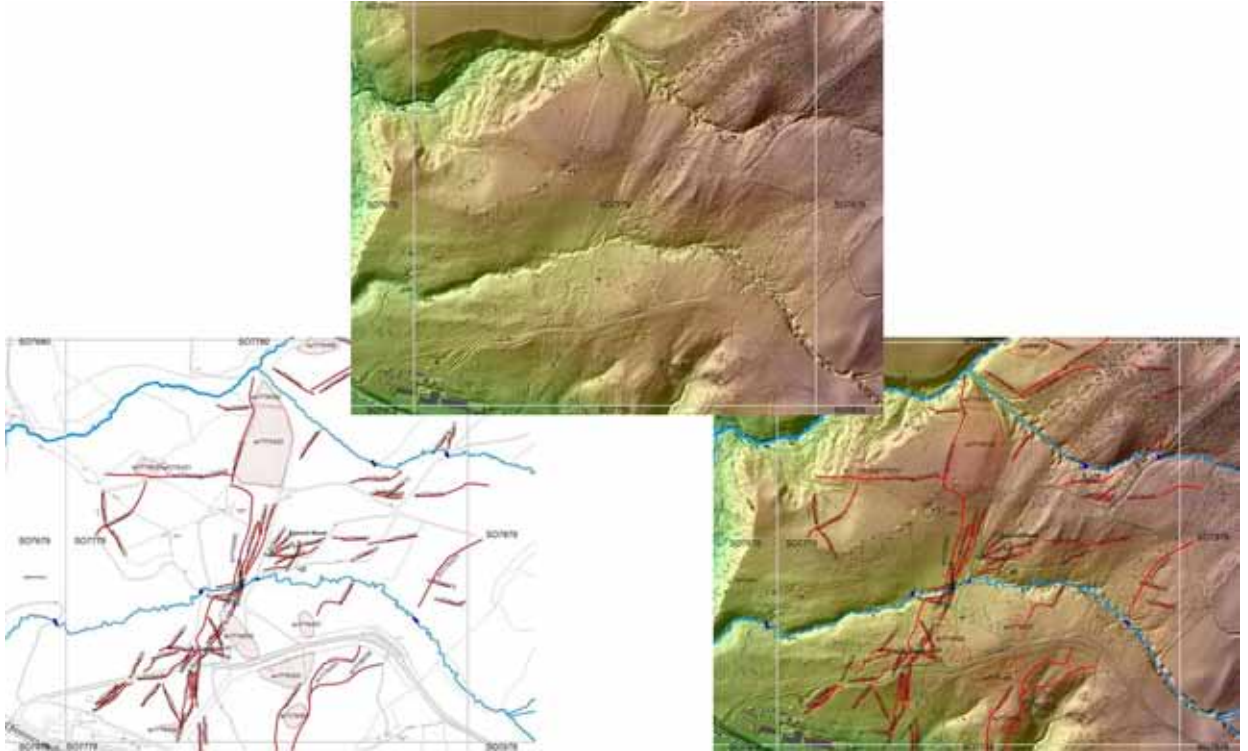


Figure 3: An example of the lidar validation map set.

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An assessment of initial validation results and volunteer experience

Volunteer validation commenced in March 2010. This was later than originally planned and a short half-day refresher workshop focusing on the fieldwork method was held, again at Pound Green Common. The fifteen pairs of volunteers were allocated their survey squares and work commenced immediately. The initial survey areas had to be based on land that was accessible, however, as far as possible survey squares were allocated in order to capture a sample of features across the whole project area. Later allocations have focused, and will continue to focus, on neighbouring squares in order to build on existing records.

As of September 2010, a total of four survey squares have been completed with another fifteen in progress. After initial work, some of the volunteer pairs had to stand-down over the spring and summer as ground cover began to obscure features. Validation has continued in some areas, in spite of the seasonal constraints; for example, in open areas of mainly pasture and in parts of the forest where there is a mature and dense tree canopy that very effectively suppresses the development of ground cover.

Records have been received for several of the in-progress areas in addition to all records for the four completed survey areas. The standard of recording has been

excellent demonstrating dedication and attention to detail. While the volunteers have been trained to work autonomously, they do have access to professional archaeological support if needed. To date, there has been only one occasion where a volunteer pair has called upon support in the field. This is in an area of Wyre, which has a long history of industrial workings in addition to many other multi-period features. Other volunteers periodically seek advice via email or a telephone conversation. In every case to date it has been possible to quickly resolve any uncertainties or queries. The initial results are comprehensive enough to affirm the high quality work being undertaken by the volunteers. It also suggests that the methodology is proving effective in what it set out to achieve – a rapid survey that is providing an interpretation, context and condition to the transcribed features; all delivered by a skilled group of motivated volunteers.

This, of course, is one opinion and it was felt necessary to address both professional and volunteer opinions as part of the assessment being presented in this paper.

A representative of the Worcestershire Historic Environment Record was invited to comment on a sample of the initial records received, with a view to their suitability for accession into the counties HERs. The following text records the consultation response (Russell 2010).

On the text recording of features

From an HER point of view one of the weaknesses of the recording form is the Feature Type List. The terms are not all from the EH thesaurus, some having been chosen as more descriptive terms instead of the more technical terms used in the HER. If terms from the thesaurus were used exclusively the HER inputting would likely be more consistent. However, using these technical terms could result in less accurate recording within the field as it could create confusion with the volunteers.

On profile drawings

The methodology is, in archaeological terms, basic, however it gives a clear indication of the depth, extent and shape of each feature, allowing for a description within the HER record. Using this method is also very quick, and any site worthy of further investigation can be flagged up from this stage.

Conclusion

The methodology is a fine balancing act between the ease of use for volunteers and the professional detail required by the project archaeologists and the HER. Volunteers are currently recording features throughout the project area and the data being returned is of an adequate quality and detail to be entered meaningfully into the HER.

A questionnaire was also circulated to the volunteers asking for their feedback. The following headings are taken directly from the questionnaire. Under each heading there is a short summary discussion of the feedback received.

Overall, has the validation methodology been practical to use in the field? Please say if it has/has not and why.

The overall assessment of the methodology ranged from it being relatively practical to very practical to apply. All respondents feel the maps are clear and helpful and that the recording method is simple and logical to follow through its series of basic steps. Several report that keeping the survey kit to a minimum has proven very helpful, particularly in those areas with more challenging terrain. The method of navigation

has also met with approval although some volunteers have continued to use their own GPS units in conjunction with compass navigation.

Please list and briefly discuss any specific elements of the methodology that particularly work well and those that may not be working so well.

A few practical issues were reported here. For example, some volunteer pairs have been encountering deep ditches with an associated bank. In such circumstances drawing the profile has proven difficult as a result of the limitations of the equipment. Each volunteer pair carries a pair of electric stock fence posts and a 30 metre tape. The posts are lightweight and have useful notches that allow the tape to be easily and quickly secured across the feature. However, the posts are only a metre in height, and therefore, where substantial features are encountered on sloping ground the posts are often of insufficient height to span the feature. Being ever resourceful, the volunteers have been making use of tree trunks to fix and level the tape – an intuitive and effective solution.

Of particular interest were references to the lidar survey images and transcription. The overall confidence rating for feature identification appears to be averaging out at around 80%. The feedback indicated that some transcribed features were not 'real' and some volunteers have reported finding features that are unrecorded on the lidar or have been missed during transcription. In many ways this reaffirms the strengths and weaknesses of lidar survey, but it also highlights the value of and need for validation.

Feedback concerning the survey maps has been generally positive, although there have been some problems relating the mapped evidence to observations in the field. One volunteer reported that some transcribed features that appear very clear in the lidar survey are very difficult to locate in certain conditions. In this case, the volunteer has produced an additional map with additional hard detail added to aid location. Areas of the forest that contain high densities of interrelated features are also proving problematic in terms of relating features observed to those transcribed.

Subjectivity of interpretation was also raised under this heading. For example, the volunteers quite correctly argue that an eroded ditch can look much like a sunken track. It is inevitable that even using a tick-box method of interpretation does not guarantee the same interpretation from two different individuals.

Did you find the workshops sufficient as a method of training for validation?

Overall, the workshop approach was considered to be a helpful vehicle for introducing the concepts and techniques of validation. One respondent felt the content could have been delivered in less time, which suggests for some volunteers a whole day workshop is excessive. However, the workshops were designed to cater for those who potentially have no previous experience of field survey, let alone landscape archaeology, and it was felt that a one day format was the minimum necessary to deliver effective training. Several respondents reported that following the initial success of the workshops, a lack of confidence and experience acted as an impediment during the early stages of their fieldwork. However, all went on to report that confidence increased with each new feature recorded. In fairness to the volunteers, the unfortunate delay that spanned between the workshops and commencement of validation will have contributed to this issue.

Based on your experience to date, do you have any suggestions for how the historic environment sector might develop lidar validation using a volunteer group for future projects?

It was perhaps unfair to ask individuals working on validation within a specific project and scenario to address what is, after all, a strategic matter. Nonetheless, some informative and related comments were returned. The importance of networking was raised. Indeed, for much of the time the volunteer pairs are working in isolation to one another, although most are liaising with neighbouring pairs where survey areas meet. Periodic gatherings throughout the fieldwork programme have been suggested as an opportunity for volunteers to gather and compare notes. 'Formal mentoring' during the initial fieldwork was suggested as method of support for building experience and confidence. As noted earlier in this paper, professional support is available for the volunteers, yet the take-up has been low. It could be this approach needs to be re-considered and perhaps should be included as a formal part of future training programmes rather than being available as an option. One final contributor suggested that volunteers should (if possible) validate 100% of a project area, but that professional archaeologists should survey 'major features'. This is an interesting two-tier approach that would have implications in terms of access, cost and time, yet is worthy of further consideration.

Conclusions

The approach to validation in *Grow With Wyre* must be taken in context. Its aim is to provide an interpretation and overview of condition for a 50% sample of transcribed features over an area of 36km². The work is being carried out by a team of trained and dedicated volunteers. It is doubtful, given the financial implications that survey on such a scale could be carried out by a contracting archaeological unit within the context of a similar HLF funded scheme. There is, after all, a need to balance funding across the many projects that define such a scheme. This constraint, of course should not lead to a survey that risks returning a poor standard of results. Indeed, there are risks and specific shortcomings in deploying a simple and highly interpretative methodology. It will not be possible to assess the full impact of ambiguity until all the validation records are submitted in late spring 2011. However, as *Grow With Wyre* progresses into its legacy stage beyond October 2011, the survey results will need to be assessed in relation to one another and interpretations will vary depending on future frameworks of assessment.

Initial results from the *Grow With Wyre* project do demonstrate that high standards can be achieved. The approach and resulting record may not be sophisticated, or perfect in the conventional sense, but it is delivering an evidence base that will lead to a step change in understanding the development of Wyre's landscape and it will underpin future management plans. This is a positive outcome for the historic environment with volunteers contributing significantly towards delivering this ambition though their lively debate and enthusiasm.

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